

## CLAIMS

### WE CLAIM:

1. A gas discharge laser comprising:
  - A) a laser chamber containing a laser gas,
  - B) two elongated electrode elements defining a cathode and an anode, each electrode having a discharge region, said electrodes being disposed within said laser chamber and said discharge region of said anode being covered with a porous insulating layer,
  - C) a pulse power system configured to provide electrical pulses at rates in excess of 1000 pulses per second to produce electric discharges, said electric discharges discharge regions on said anode and on said cathode,
  - D) a blower system for circulating said laser gas between said two electrodes at a velocity sufficient to remove substantially all debris produced by a discharge prior to a next subsequent discharge when operating at pulse rates in excess of 1000 pulses per second, and
  - E) a heat exchanger having sufficient capacity to remove heat from said laser gas produced by said blower system and said discharge.
2. A laser as in Claim 1 wherein said porous insulating layer is comprised of a metal fluoride.
3. A laser as in Claim 1 wherein said insulating layer is created by exposing said anode to electric discharges in a gas environment wherein gas in said gas environment comprises  $F_2$ .

4. A laser as in Claim 1 wherein said porous insulating layer comprises a porous alumina layer.
5. A laser as in Claim 1 wherein said porous alumina layer is an anodized alumina layer.
6. A laser as in Claim 1 where said porous insulating layer is comprised of particles comprised of an electrical insulator material.
7. A laser as in Claim 6 wherein said insulator material is a ceramic.
8. A laser as in Claim 6 wherein said insulator material is a fluoride.
9. A laser as in Claim 6 wherein said insulator material consists of a ceramic chosen from a group consisting of  $\text{Al}_2\text{O}_3$ ,  $\text{MgF}_2$  and  $\text{CaF}_2$ .
10. A laser as in Claim 1 wherein said porous insulating layer is comprised of a large number of holes.
11. A laser as in Claim 10 wherein said large number of holes is in excess of 50,000.
12. A laser as in Claim 10 wherein most of said large number of holes have widths of between 20 microns and 250 microns.
13. A laser as in Claim 1 wherein said anode has a cross section chosen to produce a high electric field over a width, defining the discharge region of said anode, of about 3.5 mm along a centerline of said anode with a sharp decrease in the electric field on both sides of said anode discharge region.

14. A laser as in Claim 1 wherein at least one of said electrode elements define a discharge surface and comprises trenches running longitudinal along two sides of said discharge surface.

15. A laser as in Claim 14 wherein said trenches are at least partially filled with insulator material.

16. A laser as in Claim 15 wherein said insulator material is chosen from a group consisting of alumina and metal fluorides.

17. A laser as in Claim 1 wherein at least one of said electrode element is comprised of a first non-insulating material having high electrical conductance defining a high conductance and a second non-insulating material having a conductance, defining a lower conductance of less than 70 percent of the high conductance, said first non-insulating material defining a discharge surface.

18. A laser as in Claim 17 wherein said material having the lower conductance of a lossy electrode material.

19. A laser as in Claim 1 wherein said anode comprises insulating sheets disposed on two sides of said discharge surface.

20. A laser as in Claim 1 and further comprising a current return structure configured to shape the discharge to a desired shape and further comprising insulating spacers to guide the gas flow through and beyond the discharge region.

21. A laser as in Claim 1 wherein said porous insulating layer is comprised of insulating particles embedded in a metal.

22. A laser as in Claim 21 wherein said metal is brass.
23. A process for producing an elongated electrode for use in a laser comprising the steps of:
- A) fabricating an elongated electrode structure comprised of one or more electrical conducting materials and having a long dimension of at least 50 centimeters and a width of at least 2 centimeters.
  - B) creating a porous insulating layer on a portion of said elongated electrode, said portion defining a discharge region having a width of at least 3 millimeters.
24. A process as in Claim 23 wherein said one or more electrical conducting materials comprise a lead rich brass having a lead content of greater than 1 percent, and said step of creating said porous electrical insulating layer comprises operating said electrode in a fluorine containing laser gas to permit a porous insulating layer to build up on the lead rich brass.
25. A process as in Claim 23 wherein said step of creating said porous insulating layer comprises spreading insulating particles on the discharge region of said elongated electrode structure.
26. A process as in Claim 23 wherein said step of creating said porous insulating layer comprises the steps of:
- A) mixing insulating particles in a molten metal to produce a discharge section of said elongated electrode said section comprising a filler metal and said insulating particles,
  - B) operating said elongated electrode in a fluorine containing laser gas environment to permit a portion of said filler metal to sputter away leaving a porous insulating layer covering said discharge region.

27. A process as in Claim 25 wherein said insulating particles have dimensions in the range of about 50 to 150 microns.

28. A process as in Claim 26 wherein said particles have dimensions in the range of about 50 to 150 microns.